

MARKSCHEME

November 2005

BIOLOGY

Higher Level

Paper 2

*This markscheme is **confidential** and for the exclusive use of examiners in this examination session.*

*It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of IBCA.*

General Marking Instructions

Subject Details: **Biology HL Paper 2 Markscheme**

Mark Allocation

Candidates are required to answer **ALL** questions in Section A total **[32 marks]** and **any TWO** questions in Section B **[20 marks]** each. Maximum total = **[72 marks]**.

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- ♦ Each marking point has a separate line and the end is signified by means of a semicolon (;).
- ♦ An alternative answer or wording is indicated in the markscheme by a “/”; either wording can be accepted.
- ♦ Words in (...) in the markscheme are not necessary to gain the mark.
- ♦ The order of points does not have to be as written (unless stated otherwise).
- ♦ If the candidate’s answer has the same “meaning” or can be clearly interpreted as being the same as that in the markscheme then award the mark.
- ♦ Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising them for what they have not achieved or what they have got wrong.
- ♦ Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts.
- ♦ Units should always be given where appropriate. Omission of units should only be penalized once.
- ♦ Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

Section B

Extended response questions - quality of construction

- ♦ Extended response questions for HL P2 carry a mark total of **[20]**. Of these marks, **[18]** are awarded for content and **[2]** for the quality of construction of the answer.
- ♦ Two aspects are considered:
 expression of relevant ideas with clarity
 structure of the answers.
- ♦ **[1]** quality mark is to be awarded when the candidate satisfies **EACH** of the following criteria. Thus **[2]** quality marks are awarded when a candidate satisfies **BOTH** criteria.

Clarity of expression:

The candidate has made a serious and full attempt to answer all parts of the question and the answers are expressed clearly enough to be understood with little or no re-reading.

Structure of answer:

The candidate has linked relevant ideas to form a logical sequence in at least two parts [(a), (b), etc.] of the question.

- ♦ It is important to judge this on the overall answer, taking into account the answers to all parts of the question. Although, the part with the largest number of marks is likely to provide the most evidence.
- ♦ Candidates that score very highly on the content marks need not necessarily automatically gain the **[2]** marks for the quality of construction (and *vice versa*).

SECTION A

1. (a) 2.9 (± 0.2) mm (*units required*) [1]

- (b) cyclic light makes style grow almost immediately while with continuous light it takes longer to start to grow / L16/D8 starts growing in first hour while L24 style starts growing after 6 hours / growth is more gradual in L24;
with continuous light the style grows less / continuous (L24) grows to 9.8 mm while cyclic (L16/D8) grows to 10.2 mm / little difference after 28 hours;
in both cases growth only starts with anthesis; [2 max]

- (c) 47 % / more fertilized ovules in cyclic light;
filament grows more in cyclic light than continuous;
pollen closer to stigma so pollination more probable;
in continuous light anthers do not become exposed; [3 max]
Accept converse wording.

- (d) standard deviation is a measure of variability / indicates the spread of values around the mean;
continuous light data is more variable (because it has a higher standard deviation);
helps to decide whether the difference between two means is significant;
68 % of values are 1 SD from mean;
difference between means is approximately 47 / appears to be significantly different / light treatment makes a significant difference; [3 max]

- (e) darkness promotes / white light inhibits because filaments shorter than in darkness;
red light inhibits because filaments shorter than in darkness;
auxins promote because filaments are longer than in control / in white and red light;
gibberellic acid inhibits because filaments are shorter in continuous white light/darkness; [3 max]
Reason must be present to receive the mark. Accept if converse wording.

- (f) self-pollination reduces/does not promote variation / no new combination of alleles;
no variation for natural selection;
more susceptible to infectious diseases;
more prone to genetic disease / (inbreeding) more likely to be homozygous for disease; [2 max]

2. (a) I: stomach = digestion of proteins (by pepsin) / bacteria / foreign matter killed by acid / mechanical digestion / chemical digestion / rennin secretion / hydrochloric acid production;
Do not accept breakdown of food.
- II: large intestine = absorption of water / production/absorption of vitamin K / store waste before excretion; **[2 max]**
The correct name and function are needed to receive a mark.
- (b) salivary gland;
pancreas; **[2]**
Correct name and label are needed to receive the mark.
- (c) large surface area by microvilli / protrusion of exposed parts;
epithelium only one layer thick;
protein channels allow facilitated diffusion and active transport;
mitochondria provide ATP;
blood capillaries close to epithelium/surface;
absorption of glucose / amino acids;
lacteal / lymphatic vessel in centre to absorb fats;
tight junctions assist in controlling absorption; **[3 max]**
Award marks for a clearly drawn and correctly labelled diagram.
3. (a) 5'————→3' **[1]**
Award the mark only if a single headed arrow is shown.
- (b) Alanine / Ala **[1]**
- (c) an activating enzyme attaches amino acid to the tRNA;
specific enzyme for specific tRNA;
recognizes tRNA by its shape / chemical properties;
energy (ATP) is needed;
amino acid attached at 3' end;
amino acid attached at CCA; **[3 max]**
- (d) rough ER;
cytoplasm;
chloroplast (stroma of) / mitochondria (matrix of); **[1 max]**

4. (a) (i) CO_2 ;
nitrogenous compound / urea;
water; *[1 max]*
- (ii) waste substances are toxic / can cause damage / harmful *[1]*
- (b) red and blue light is absorbed and green light is reflected / blue light is absorbed the most and green light is absorbed the least *[1]*
- (c) can be bacteria/fungi;
feed on / rot dead organisms / organic matter;
(secrete) enzymes to break down (organic) matter;
becomes inorganic matter;
without decomposers nutrients would become unavailable / decomposers release nutrients to soil; *[2 max]*

SECTION B

Remember, up to TWO “quality of construction” marks per essay.

5. (a) pyruvate is decarboxylated / CO_2 removed;
 link reaction / pyruvate combined with CoA / ethanoyl/acetyl CoA formed;
 pyruvate is oxidized / hydrogen removed;
 reduction of NAD / formation of $\text{NADH} + \text{H}^+$;
 whole conversion called oxidative decarboxylation;
 Krebs cycle;
 $\text{C}_2 + \text{C}_4 \longrightarrow \text{C}_6$;
 $\text{C}_6 \longrightarrow \text{C}_5$ giving CO_2 ;
 $\text{C}_5 \longrightarrow \text{C}_4$ giving CO_2 ;
 hydrogen atoms removed collected by hydrogen-carrying coenzymes;
 ATP formed by substrate level phosphorylation;
 oxygen accepts electrons / oxygen combines with hydrogen;
 total yield per turn of Krebs cycle = 2CO_2 , $3\text{NADH} + \text{H}^+$, 1FADH_2 , 1ATP (directly produced); **[8 max]**
- (b) aerobic uses oxygen and anaerobic does not;
 aerobic produces more energy / higher yield of ATP per gram of glucose;
 aerobic pyruvate broken to CO_2 and H_2O and in anaerobic to lactate/ethanol + CO_2 ;
 aerobic occurs in mitochondria and anaerobic in cytoplasm of eukaryotic cells; **[4 max]**
Allow tabular presentation but do not deduct marks if comparison does not occur within the same statement as this is not a comparison question.
- (c) rate of reaction increases as temperature increases;
 due to greater collision frequency / greater proportion of molecules will have more energy / activation energy;
 maximum rate achieved at optimum temperature;
 rate decreases above optimum temperature;
 at high temperatures enzymes are denatured;
 heat causes vibrations inside enzymes;
 which breaks bonds needed to maintain structure of enzymes;
 substrate should fit in active site / induced fit model;
 shape of active site changes so substrate is not recognized / cannot bind; **[6 max]**
Award marks for a clearly drawn and correctly annotated graph.

(Plus up to **[2]** for quality)

6. (a) *Award [1] for each of the following structures clearly drawn and correctly labeled.*

developing oocytes;
 primary oocyte;
 zona pellucida;
 mature (Graafian) follicle;
 secondary oocyte;
 corpus luteum;
 corpus albicans;
 egg being released / site of ovulation;
 outer layer of germ cells / germinal epithelium;
 medulla;
 stroma;
 region where blood vessels enter and leave;

[5 max]

- (b) sperm approaches ovum in oviduct/uterus;
 sperm attaches to receptors in zona pellucida;
 acrosome reaction / enzymes digest;
 membrane of sperm fuses with oocyte membrane;
 cortical reaction / conical granules / lysosomes release enzymes;
 zona thickens so no sperm enters / cross-linking of glycoproteins;
 male nucleus swells;
 secondary oocyte / female cell completes meiosis II;
 mention of fast block / slow block to polyspermy;

[5 max]

- (c) *cause:*
 acquired immunodeficiency syndrome;
 caused by HIV/human immunodeficiency virus,
 low number of T-helper cells;
 less antibodies produced;
 body vulnerable to pathogens;

transmission:
 transmission through body fluids / does not live long outside the body;
 through sexual intercourse;
 sharing of needles;
 across placenta;
 blood transfusions;
 blood products / factor VIII used to treat hemophiliacs;

social implications:
 families and friends suffer grief;
 great costs/reduction in workforce/economic implications;
 discrimination;
 increase in number of orphans / family structure / stability affected;

[8 max]

The answer must include at least one reference to cause, transmission and social implications in order to receive full marks.

(Plus up to [2] for quality)

7. (a) in resting potential;
sodium is pumped out by active transport and potassium in;
a concentration gradient builds up electrical potential/voltage;
negative inside compared to outside;
when impulse passes / action potential;
must pass threshold level;
sodium channels open and ions diffuse into neuron;
membrane depolarized;
potassium diffuse out across membrane through ion channels;
active transport of ions once more;
slower in un-myelinated neuron than in myelinated;
an action potential in one part of the neuron causes the action potential to develop
in the next section; **[8 max]**
- (b) formed of central nervous system;
brain and spinal cord;
peripheral nervous system divided into voluntary and autonomic nervous systems;
autonomic nervous system consists of sympathetic and parasympathetic nervous system;
voluntary nervous system has motor and sensory neurons; **[4 max]**
- (c) natural active immunity by catching the disease;
antigen presentation by macrophages/MHC proteins;
helper T-cells activated;
lymphocytes / B-cells react forming antibodies;
clonal selection / multiply when they encounter antigen;
polyclonal if more than one clone formed;
memory cells formed;
natural passive immunity by placenta / breast feeding;
artificial active by vaccination / Sabin vaccine / Salk vaccine;
artificial passive by injection of antibodies; **[6 max]**

(Plus up to [2] for quality)

- P genotype shown;
P phenotype stated;
gametes;
F₁ genotype;
F₁ phenotype;
gametes;
F₂ genotype;
F₂ phenotype;

L= long wings
l= short wings
R= red eyes
r= white eyes

long wing red eyes x short wings white eyes;

$$F_1 \quad \begin{array}{c} L \\ R \end{array} \left| \begin{array}{c} l \\ r \end{array} \right|;$$

Gametes L and l
 R r

75 % long wings, red eyes 25 % short wings white eyes;

[8 max]

Award [6 max] if the example of the genes is not correct but the rest of the outline is carried through correctly. i.e. the example of genes chosen are not linked but the rest of the outline is correct. Linkage notation is expected for points in the markscheme where it is shown.

- (b) example of co-dominance;
 multiple alleles/3 alleles;
 (phenotype) 0 has (genotype) ii;
 A can be $I^A I^A$ **or** $I^A i$;
 B can be $I^B I^B$ **or** $I^B i$;
 AB is $I^A I^B$;
 (P are) $ii \times I^A I^A$;
 (gametes) i and I^A ;
 (F_1 genotype) $I^A i$;
 (F_1 phenotype) blood group A;

[5 max]

Accept other notations if used consistently and if phenotype and genotype are clearly distinguished.

- (c) gene carried on sex chromosome / X chromosome / Y chromosome;
 inheritance different in males than in females;
 males have only one X chromosome therefore, only one copy of the gene;
 mutation on Y chromosome can only be inherited by males;
 women can be carriers if only one X chromosome affected;
 example of sex linked characteristics (e.g. hemophilia / colour blindness);
 example of cross involving linkage;

[5 max]

(Plus up to [2] for quality)